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Kiyooka

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(54) **CONNECTOR**

(71) Applicant: **PANASONIC CORPORATION**, Osaka (JP)

(72) Inventor: **Takashi Kiyooka**, Mie (JP)

(73) Assignee: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka (JP)

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(51) **Int. Cl.**

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H01R 12/88	(2011.01)
H01R 12/77	(2011.01)
H01R 13/24	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/62994*** (2013.01); ***H01R 12/88*** (2013.01); ***H01R 13/62977*** (2013.01); *H01R 12/771* (2013.01); *H01R 13/2435* (2013.01); *H01R 13/2442* (2013.01)

(58) **Field of Classification Search**

CPC H01R 13/62994

USPC 439/260, 261, 266, 267, 492–495

See application file for complete search history.

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Primary Examiner — James Harvey

(74) *Attorney, Agent, or Firm* — McDermott Will & Emery LLP

(57) **ABSTRACT**

A connector includes: at least one of a contact **5**; a housing **3** accommodating the contact **5**; an insertion opening **4** to which a flat cable **2** can be inserted, the insertion opening **4** being provided in front part of the housing **3** and being defined by upper and lower walls **33** and **32** of the housing **3** at the top and bottom; and a lever **6** which is provided in back part of the housing **3** and includes cam portions **61** which bring the contact **5** into pressure contact with the flat cable **2** and establish electrical continuity therebetween when the lever **6** is turned. The contact **5** includes a contact **5**A having a placement surface S**1** which is located at a substantially same height position in the vertical direction as a contact surface S**2** of the corresponding cam portion **61** in the housing **3**.

8 Claims, 8 Drawing Sheets

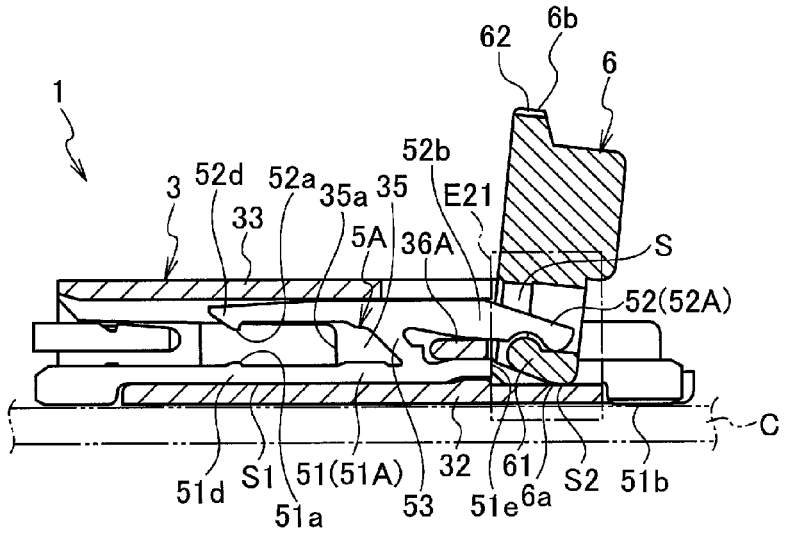
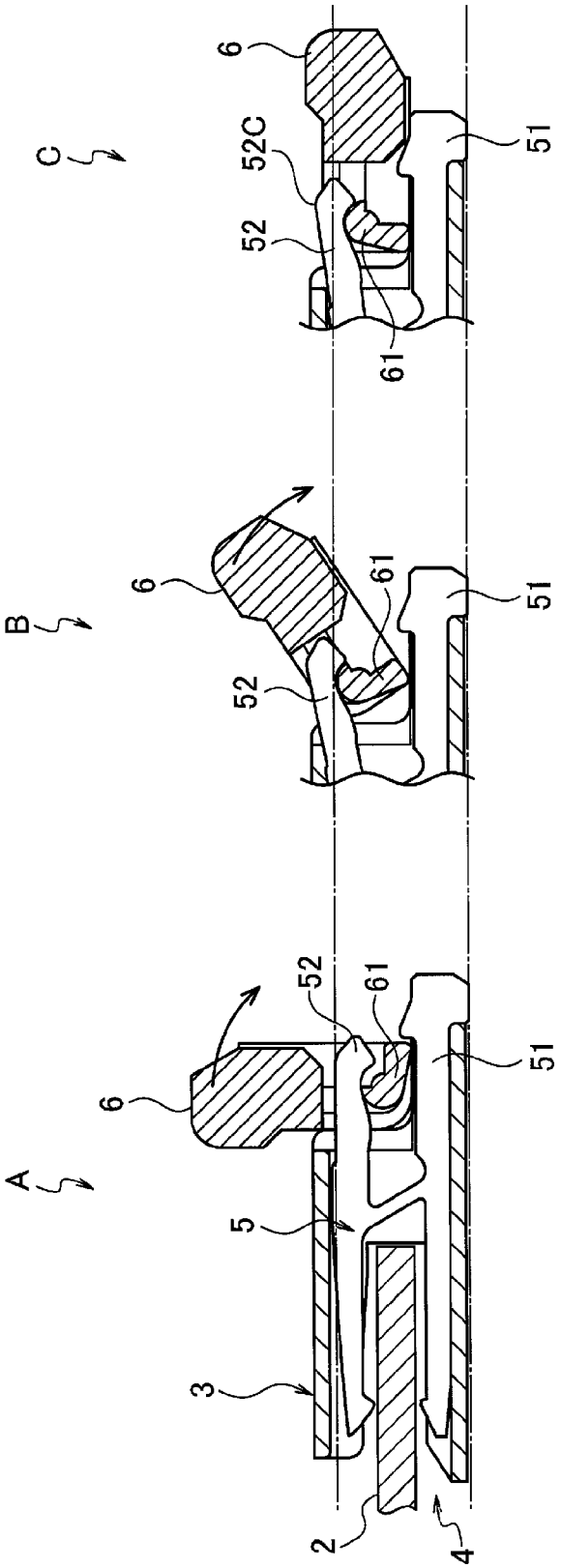


FIG. 1



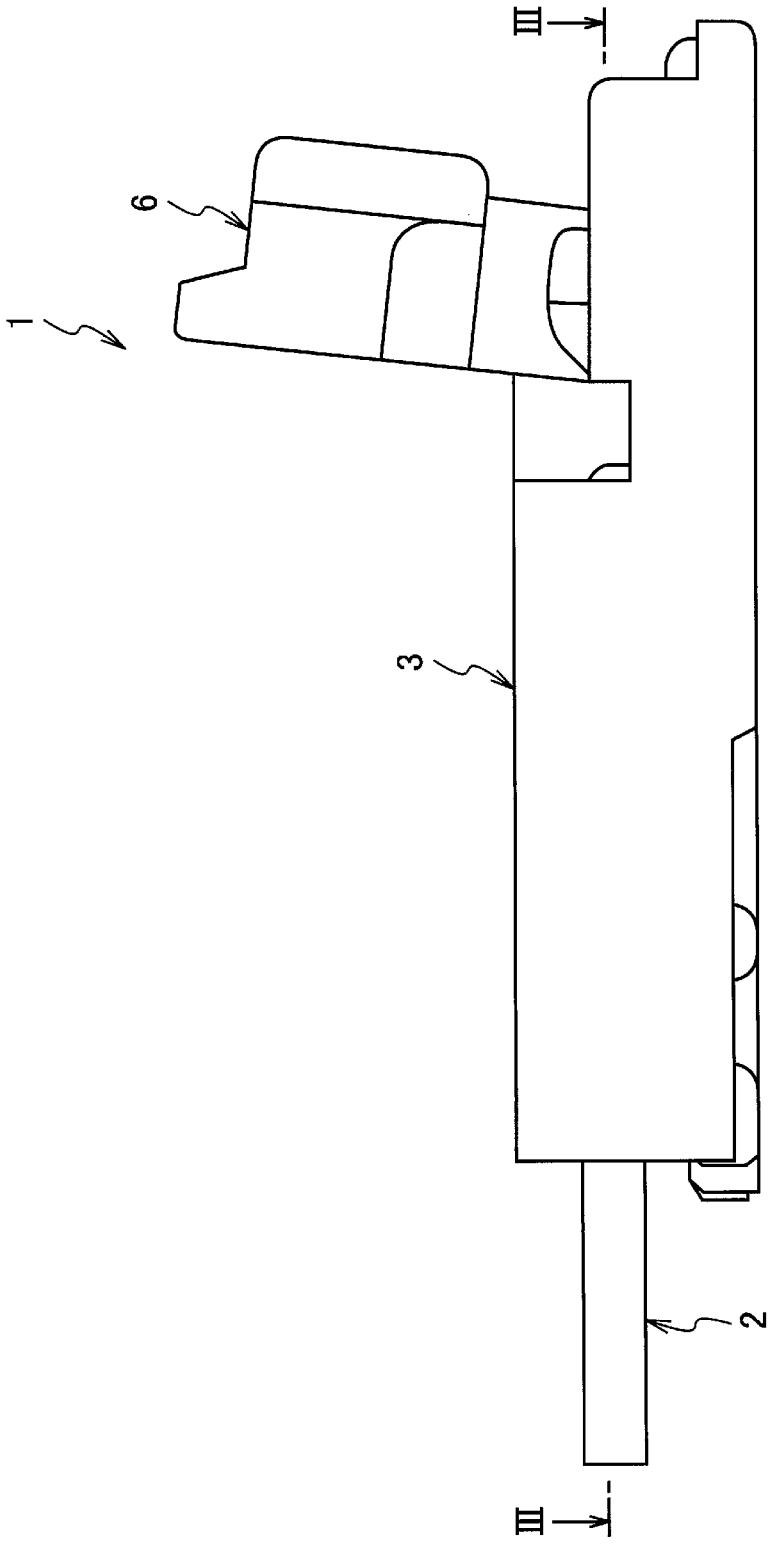


FIG. 2

FIG. 3

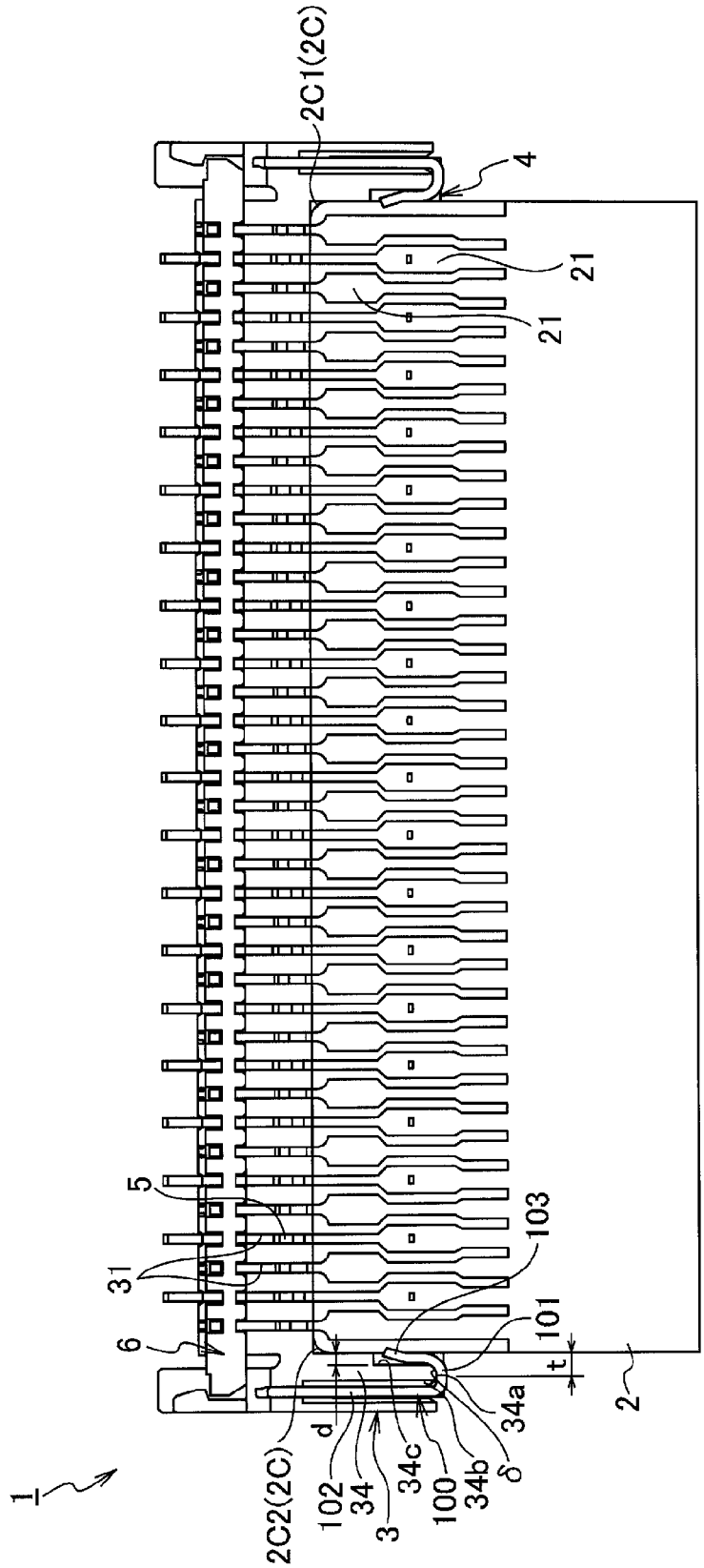


FIG. 4

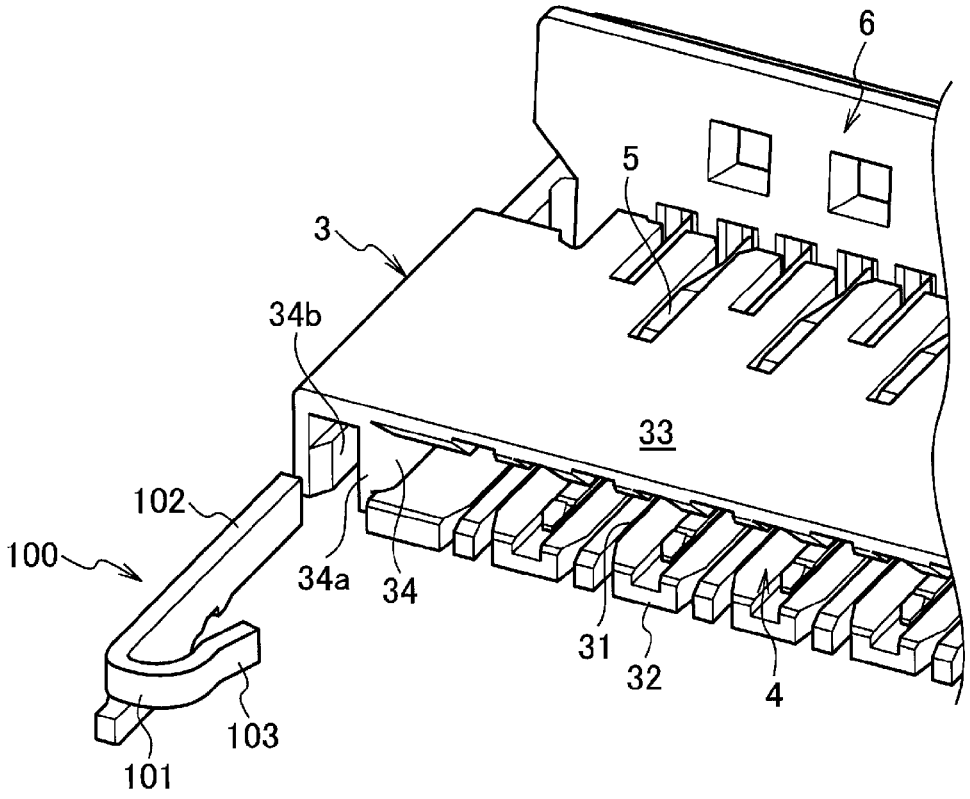


FIG. 5

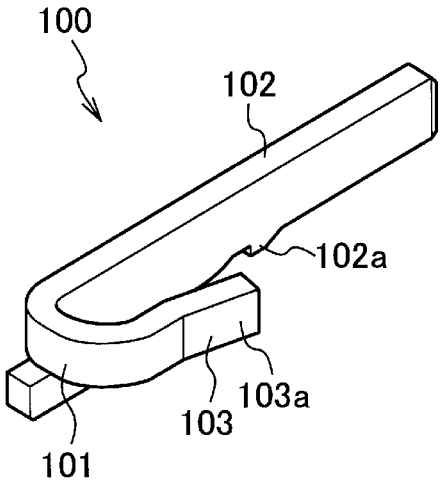


FIG. 6

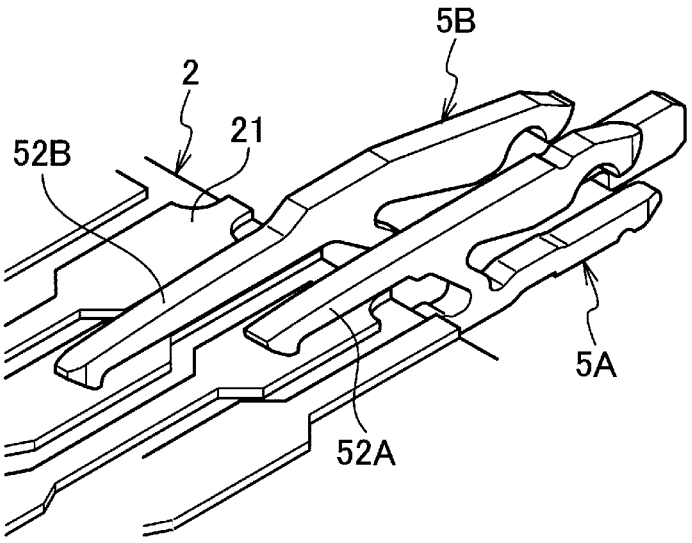


FIG. 7A

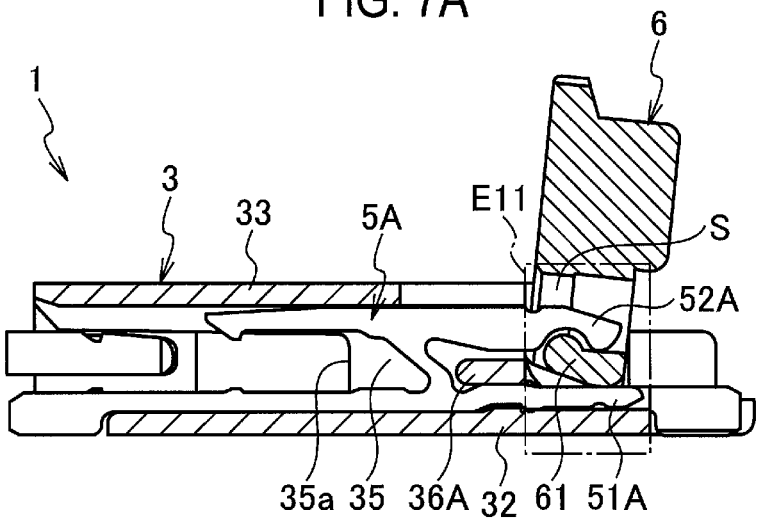

6
1
3
33
5A
E11
S
52A
35a
35
36A
32
61
51A

FIG. 7B

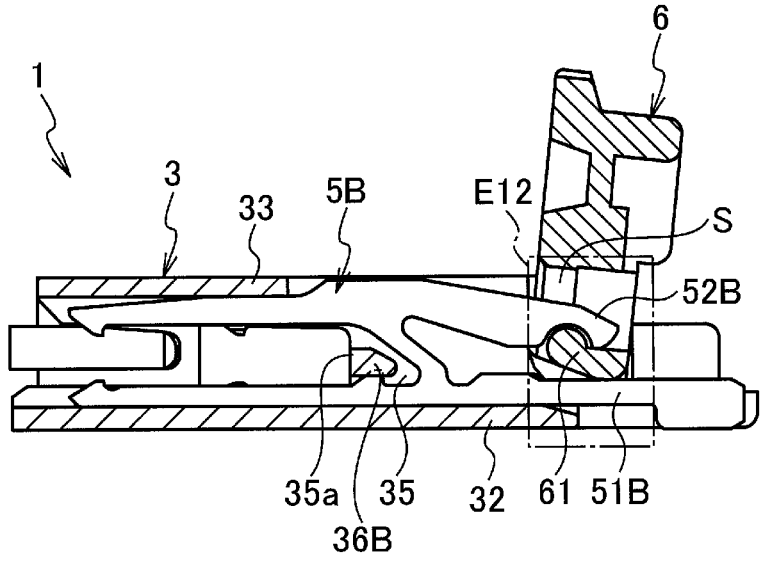

6
1
3
33
5B
E12
S
52B
35a
35
32
61
51B
36B

FIG. 8A

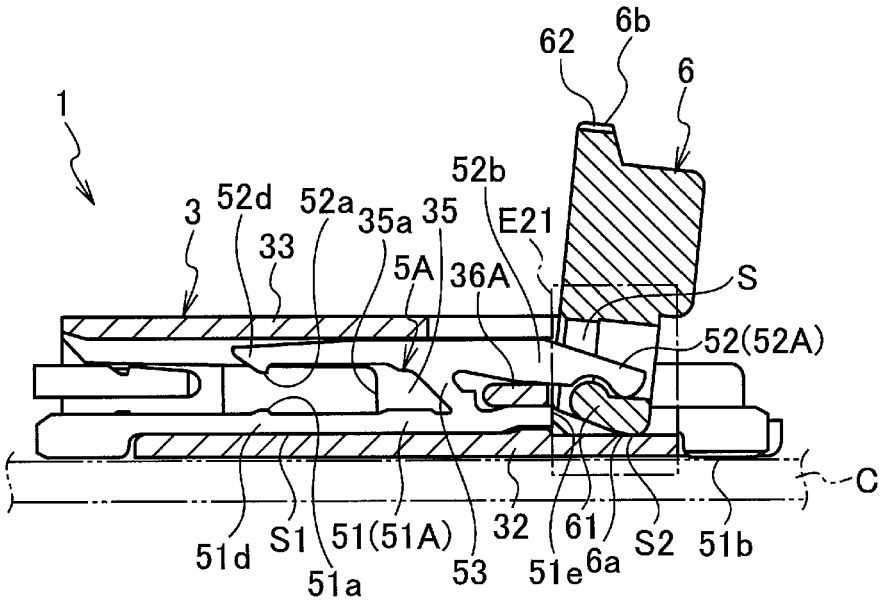
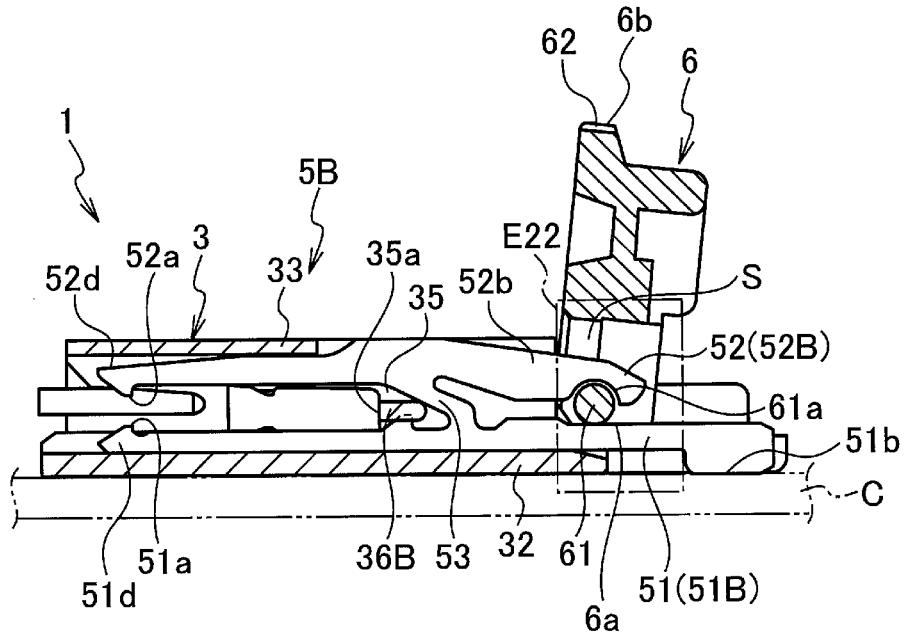

62
6b
6
1
52b
3
52d
52a
35a
35
E21
33
5A
36A
S
52(52A)
C
51d
S1
51(51A)
32
61
S2
51b
51a
53
51e
6a

FIG. 8B


62
6b
6
1
5B
E22
3
52a
35a
52d
33
52b
S
35
52(52B)
61a
51b
C
51d
51a
36B
53
32
61
51(51B)
6a

CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Application P2012-199181 filed on Sep. 11, 2012; the entire contents of which are incorporated by reference herein.

BACKGROUND OF THE INVENTION

The present invention relates to a connector.

Conventionally-known connectors include front-lock connectors having a lever in the front part of the housing (in the insertion opening side) and back-lock connectors having a lever in the back part of the housing.

The housing accommodates electrically-conductive contacts. Each contact includes a pair of arms which are positioned on the upper and lower sides of a flat cable. The flat cable is inserted between the pair of arms. When the lever is operated in this state, the pair of arms sandwich the upper and lower surfaces of the flat cable with the front ends thereof about a fulcrum, provided between the both arms, as a center.

In this process, the rotation force of the lever acts on the front end side of each arm with respect to the fulcrum in a front-lock connector. On the other hand, in a back-lock connector, the rotation force of the lever acts on the back end side of each arm with respect to the fulcrum. In other words, the front-lock connector is configured to hold the flat cable by causing the rotation force of the lever to directly act in such a direction as to close the front end of the connector. On the other hand, the back-lock connector holds the flat cable at the front end, which is closed by causing the rotation force of the lever to act in such a direction as to open parts of the arms backward of the fulcrum of the connector. The front-lock and back-lock connectors, therefore, differ from each other in position where the rotation force of the lever acts on the contacts, such as forward of or backward of the fulcrum. However, the back-lock connectors can include space to accommodate the laid-down lever in the backward of the contacts and can have a lower profile than the front-lock connectors have.

Japanese Patent Laid-open Publication No. 2008-4404 describes a back-lock connector. In the back-lock connector, the cam portion made of synthetic resin is configured to slide on an insulator made of synthetic resin while minimizing sliding on the metallic contacts. This can very effectively prevent the cam portion from being worn even when an actuator is repeatedly turned, and the cam portion can, therefore, keep the shape thereof.

SUMMARY OF THE INVENTION

The connectors are increasingly demanded to have a lower profile as electronic devices are miniaturized. However, a conventional connector includes a number of constituent parts around the cam portion, and it is, therefore, difficult to reduce the height of the connector.

Hereinafter, a description is given of the aforementioned problem of the conventional connectors in more detail, using FIG. **1**. Specifically, as indicated by A of FIG. **1**, a contact **5** includes a moving arm **52** and a fixed arm **51** which are joined to form a substantially H-shape. In the back part of the housing **3**, a lever **6** is provided. At an end of the lever **6**, a cam portion **61** is provided. As illustrated by A of FIG. **1**, the lever **6** is raised in an unlocked position at the initial state. After a

flat cable **2** is inserted into the insertion opening **4**, the lever **6** is turned backwards into the locked position as illustrated by B and C of FIG. **1**. In the locked position, the flat cable **2** and contacts **5** establish electrical continuity. The portion indicated by reference numeral **52**C of C in FIG. **1** is at the highest position in the moving arm **52**. The higher the maximum point, the more difficult it is to reduce the height of the connector.

Accordingly, an object of the present invention is to provide a connector which can be reduced in height.

The present invention is a connector, including: at least one of a contact; a housing accommodating the contact; an insertion opening to which a flat cable can be inserted, the insertion opening being provided in front part of the housing and being defined by upper and lower walls of the housing at the top and bottom; and a lever which is provided in back part of the housing and includes cam portions which bring the contact into pressure contact with the flat cable and establish electrical continuity therebetween when the lever is pivoted. In the connector, the contact includes a first contact having a placement surface which is located at a substantially same height position in the vertical direction as a contact surface of the corresponding cam portion in the housing.

In the present invention, the connector may include a plurality of contacts and the contacts may include a second contact having a different effective fitting length from that of the first contact.

Moreover, in the present invention, the contacts may include a moving arm and a fixed arm which are joined to form a substantially H shape, the moving arm being driven by the corresponding cam portion, the fixed arm being fixed to the housing, and the fixed arm of the first contact may be shorter than the moving arm and may be provided to face the moving arm together with the corresponding cam portion.

Furthermore, in the present invention, an end face of the fixed arm of the first contact may face the corresponding cam portion, the end face being located at an end of the fixed arm in the horizontal direction.

Still furthermore, in the present invention, the cam portion corresponding to the first contact may rotate on the lower wall of the housing as a contact surface.

Still furthermore, in the present invention, when the lever is turned, the cam portion corresponding to the first contact may apply pressure to the first contact while the cam portion corresponding to the second contact prevents the lever from falling off.

Still furthermore, in the present invention, the cam portion corresponding to the second contact may be columnar.

Still furthermore, in the present invention, the first contact may have an effective fitting length shorter than that of the second contact and may be located at an odd-numbered position from an end while the second contact is located at an even-numbered position from the end.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view for explaining the problem of a conventional connector, A illustrating the state of the connector before the lever is turned, B illustrating the state thereof while the lever is being turned, and C illustrating the state thereof after the lever is turned.

FIG. **2** is a side view of a connector according to an embodiment of the present invention.

FIG. **3** is a cross-sectional view taken along a line of FIG. **2**.

FIG. **4** is a perspective view illustrating attachment of a protection member illustrated in FIG. **3**.

FIG. **5** is an enlarged perspective view of the protection member illustrated in FIG. **4**.

FIG. **6** is a perspective view illustrating a relationship between contacts according to the embodiment of the present invention and a flat cable.

FIGS. **7**A and **7**B are cross-sectional views schematically illustrating a connector according to a comparative example, FIG. **7**A being a cross-sectional view of an odd-numbered contact, FIG. **7**B being a cross-sectional view of an even-numbered contact.

FIGS. **8**A and **8**B are cross-sectional views schematically illustrating the connector according to the embodiment of the present invention, FIG. **8**A being a cross-sectional view of an odd-numbered contact, FIG. **8**B being a cross-sectional view of an even-numbered contact.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, a description is given of an embodiment of the present invention in detail with reference to the drawings.

FIGS. **2** to **8**B (except FIGS. **7**A and **7**B) are views illustrating an embodiment of a connector **1** according to the present invention. The connector **1** connects a flat cable **2**, such as an FPC (flexible printed circuit) or an FFC (flexible flat cable), to a circuit substrate C (see FIGS. **8**A and **8**B) to establish electrical continuity therebetween.

As illustrated in FIGS. **2** and **3**, the connector **1** includes an insulating housing **3**. In the front part (lower part in FIG. **3**) of the housing **3**, an insertion opening **4** is provided, into which the flat cable **2** can be inserted. The housing **3** accommodates plural conductive contacts **5** that can be freely connected to the flat cable **2** inserted into the insertion opening **4** to establish electrical continuity therebetween. The contacts **5** are arranged side by side in an orderly fashion.

In the back part (upper part in FIG. **3**) of the housing **3**, a lever **6** is attached. The lever **6** is turned to bring the contacts **5** into pressure contact with the flat cable **2** so that the contacts **5** and flat cable **2** are connected to establish electrical continuity therebetween.

The housing **3** is made of an insulating material such as synthetic resin. The housing **3** includes plural slots **31** to which the contacts **5** are attached. The slots **31** penetrate in the front-back direction of the housing **3** (in the vertical direction of FIG. **3**) and are arranged in the cross direction (in the width direction: in the horizontal direction of FIG. **3**). The width of each slot **31** is defined by partition walls **35**. Each partition wall **35** includes a cutout portion **35***a* which is opened toward the front side and allows the flat cable **2** to be inserted therein. The plural contacts **5** are attached to the respective slots **31** and are thereby arranged side by side in an orderly fashion.

As illustrated in FIG. **4**, the insertion opening **4** is defined by a lower wall **32**, an upper wall **33**, and side walls **34** as a flat rectangular shape extending in the cross-direction. More specifically, the insertion opening **4** is defined by the upper and lower walls **33** and **32** of the housing **3** at the top and bottom and is defined by the side walls **34** at both ends in the width direction. As a matter of course, the opening area of the insertion opening **4** has vertical and horizontal dimensions commensurate with the thickness and width of the flat cable **2**. The housing **3** only needs to define the top and bottom of the insertion opening **4** with the upper and lower walls **33** and **32**, and the both ends of the insertion opening **4** may be defined by side walls made of a material different from the housing **3** (for example, metallic plates, resin plates, or the like).

The contacts **5** are formed by using a press for punching out a conductive material sheet having a predetermined thickness, for example. Each of the thus-formed contacts **5** includes a bar-shaped fixed arm **51** and a bar-shaped moving arm **52**. The fixed arm **51** extends in the front-back direction (in the vertical direction in FIG. **3**). The moving arm **52** extends in the same direction as the fixed arm **51** extends and faces the fixed arm **51** in the thickness direction of the flat cable **2**. The fixed and moving arms **51** and **52** have longitudinally intermediate portions joined with a joint spring portion **53** to form a substantially H shape as a whole (see FIGS. **8**A and **8**B). The joint spring portion **53** serves as a fulcrum when the moving arm **52** opens or closes. At the back end of the fixed arm **51**, a terminal portion **51***b*, which is mounted on the circuit substrate C, is provided. Through the terminal portion **51***b*, the contact **5** and the circuit substrate C establish electrical continuity. Furthermore, the back end of the moving arm **52** includes a spring portion **52***b*.

The lever **6** is integrally molded by injection molding of an insulating material such as synthetic resin and includes a cam portion **61** at an end **6***a* (at the lower end in FIGS. **8**A and **8**B). The cam portion **61** produces pressing force at the fixing arm contact portion **51***a* and moving arm contact portion **52***a* of each contact **5** in the closing direction. At the other end **6***b* (at the upper end in FIGS. **8**A and **8**B), an operating portion **62** for turning the lever **6** is provided. In this embodiment, the height of the connector **1** is reduced by reducing the number of constituent parts around the cam portion **61** (described later).

The lever **6** is raised in an unlocked position at the initial state. Meanwhile, the lever **6** is brought into the locked position when turned backward to be laid down after the flat cable **2** is inserted into the insertion opening **4**. In this locked position, the flat cable **2** and contacts **5** establish electrical continuity therebetween. Specifically, when the operation portion **62** of the lever **6** is turned backward to be laid down, the cam portion **61** works so as to push apart the back ends of the fixed and moving arms **51** and **52** of each contact **5**. The fixed arm **51** and moving arm **52** then move so that the front ends **51***d* and **52***d* are closed about the joint spring portion **53** as the fulcrum. Therefore, the fixed and moving arm contact portions **51***a* and **52***a*, which are provided for the front ends **51***d* and **52***d* of the fixed and moving arms **51** and **52**, respectively, can strongly sandwich the both surfaces of the flat cable **2**. This can prevent the flat cable **2** from falling off while establishing the electrical continuity between the contacts **5** and flat cable **2**.

As described above, in the back-lock connector **1**, the lever **6** can be provided in the backward of the contacts **5** so as not to overlap the contacts **5** when the lever **6** is in the locked position. This can facilitate reducing the height of the connector **1** compared to front-lock connectors.

As illustrated in FIGS. **3** and **4**, in the insertion opening **4**, into which the flat cable **2** is inserted, protection members **100** protecting the side walls **34** of the insertion opening **4** are provided. As illustrated in FIG. **5**, each protection member **100** includes a straight attachment portion **102**. An end of the straight attachment portion **102** is bent in a U-shape, and the portion bent in the U shape constitutes a guard portion **101** protecting a front surface **34***a* of the corresponding side wall **34**. The guard portion **101** is integrally formed by processing a part (the end portion) of the attachment portion **102**. Preferably, the protection members **100** are entirely made of a metallic material excellent in abrasion resistance, such as phosphor bronze, brass, titanium copper, beryllium copper, and stainless, for example.

On the other hand, as illustrated in FIG. **3**, an attachment hole **34***b* is formed in each side wall **34** with a predetermined thickness t left inside so as to extend in the same direction as

the side wall **34** extends. In the attachment hole **34***b*, the attachment portion **102** of the protection member **100** is inserted. When the attachment portion **102** is inserted into the attachment hole **34***b*, the U-shaped guard portion **101** of the protection member **100** covers the front surface (front end) **34***a* of the side wall **34**.

In the middle of the lower side of the attachment portion **102**, an engagement protrusion **102***a* is provided. The engagement protrusion **102***a* is configured to be engaged with an engagement recess (not shown) provided for the attachment hole **34***b*. The engagement protrusion **102***a* is engaged with the engagement recess to be prevented from falling off.

Each of the protection members **100** includes a cable holding portion **103** extending from the end of the guard portion **101** towards the inside of the insertion opening **4**. The cable holding portion **103** is configured to apply a certain pressure-energization force to both sides of the flat cable **2**. In such a manner, the protection member **100** includes the guard portion **101**, attachment portion **102**, and cable holding portion **103**, thus forming a hook shape as a whole.

While each protection member **100** is provided with the cable holding portion **103**, a slot **34***c* with a depth d is provided in the inside of each side wall **34** of the insertion opening **4** as a space to accommodate the cable holding portion **103**. Preferably, the depth d of the slot **34***c* is equal to or slightly larger than the thickness of the cable holding portion **103**.

The cable holding portion **103** of this embodiment is extended from the end of the guard portion **101** toward the inside of the insertion opening **4** along the side wall **34**, and a front end portion **103***a* thus extended is slightly bent toward the center of the insertion opening **4** in the width direction. Accordingly, the front end portion **103***a* of the cable holding portion **103** protrudes a little beyond the inner side of the side wall **34** into the insertion opening **4** in a natural state. Because of the resilient force of the guard portion **101** bent in the U shape, the cable holding portions **103** have energization force that pushes the corresponding side surface of the inserted flat cable **2**.

FIG. **3** illustrates the natural state of the cable holding portion **103**, and the front end portion **103***a* of the cable holding portion **103** protrudes inward beyond the corresponding side surface of the flat cable **2**. However, in an actual state where the flat cable **2** is inserted into the insertion opening **4**, the front end portion **103***a* of the cable holding portion **103** is pushed by the corresponding side surface of the flat cable **2** toward the outside of the side surface.

As illustrated in FIG. **3**, moreover, when the protection members **100** are attached to the respective side walls **34**, a predetermined gap δ is provided between the guard portion **101** of each protection member **100** and the front surface **34***a* of the corresponding side wall **34**.

The surface of each protection member **100** of this embodiment is plated. The protection members **100** are attached to the respective side walls **34** of the insertion opening **4**. The paired protection members **100** are placed symmetrically.

In the connector **1** of this embodiment, the terminal portions **51***b* of the contacts **5** are mounted on the circuit board C as described above. On the other hand, when the lever **6** is brought into the locked position after the flat cable **2** is inserted into the insertion opening **4** of the connector **1**, the flat cable **2** and the contacts **5** establish electrical continuity. Accordingly, by bringing the lever **6** into the locked position with the flat cable **2** being inserted into the insertion opening **4**, the flat cable **2** and circuit substrate C establish electrical continuity through the contacts **5**.

FIG. **6** is a perspective view illustrating the relationship between the contacts **5**A and **5**B and the flat cable **2**. As illustrated in FIG. **6**, signal terminals **21** of the flat cable **2** are arranged in a zigzag manner. The two types of contacts **5**A and **5**B have different effective fitting length (arm length between the joint spring portion and the moving arm contact portion) so as to fit to the signal terminals **21** arranged in a zigzag manner. Specifically, the effective fitting length of the contacts **5**B, which are arranged at the even-numbered positions from one end in the width direction of the housing **3**, is longer than that of the contacts **5**A, which are arranged at the odd-numbered positions from the one end. In this embodiment, the contacts **5**A and **5**B are alternately arranged side by side so that the contacts **5** at the both ends in the width direction of the housing **3** are the contacts **5**A, which have short effective fitting length. Accordingly, the contacts **5**A are located at odd-numbered positions from either end in the width direction of the housing **3**, and the contacts **5**B are located at even-numbered positions from either end in the width direction of the housing **3**.

As described above, in this embodiment, the contacts **5** include the contacts (first contacts: contacts having short effective fitting length) **5**A and the contacts (second contacts: contacts having long effective fitting length) **5**B. The number of types of the contacts **5** is not limited to two and may be one, three, or more.

The contacts **5**A are inserted (press-fitted) into the respective slots **31** from the front side (one side in the press-fit direction), and the contacts **5**B are inserted (press-fitted) into the respective slots **31** from the back side (the other side in the press-fit direction). In other words, in this embodiment, the contacts **5**A and **5**B are inserted into the respective slots **31** in the different directions to be press-fitted into the housing **3**. As for the contacts **5**A, in this process, each contact **5**A is inserted into between the upper and lower walls **33** and **32** of the housing **3** so that back part of the fixed arm **51**A thereof is press-fitted into between the lower wall **32** and a joint wall **36**A connecting the adjacent partition walls **35**. On the other hand, as for the contacts **5**B, each contact **5**B is inserted into between the upper and lower walls **33** and **32** of the housing **3** so that front part of the contact **5**B is press-fitted into between the lower wall **32** and a joint wall **36**B. The joint wall **36**B is provided at the center of the corresponding slot **31** so that the front end substantially corresponds to the back end of the cutout portion **35***a* in a side view. Moreover, the joint wall **36**B is configured to connect the adjacent partition walls **35**.

In the following description, the contacts **5**A located at odd-numbered positions from an end are called just odd contacts or short effective fitting length contacts in some cases. Moreover, the contacts **5**B located at even-numbered positions from an end are called just even contacts or long effective fitting length contacts in some cases.

Next, a description is given of a structure to reduce the height around the cam portion **61**.

FIG. **7** is a cross-sectional view schematically illustrating a connector **1** according to a comparative example, FIG. **7**A illustrating an odd contact, FIG. **7**B illustrating an even contact. In order to identify the odd and even contacts, the contacts **5**, fixed arms **51**, and moving arms **52** of the odd contacts are called "contacts **5**A", "fixed arm **51**A", and "moving arm **52**A", respectively. The contacts **5**, fixed arms **51**, and moving arms **52** of the even contacts are called "contacts **5**B", "fixed arm **51**B", and "moving arm **52**B", respectively.

As already described, since a conventional connector includes a lot of constituent components around the cam portions **61**, the height of the conventional connector is difficult to reduce. Specifically, as illustrated in FIGS. **7**A and **7**B,

there are a lot of constituent components such as the moving arms **52**A and **52**B, the fixed arms **51**A and **51**B, and the lower wall **32** of the housing **3**, including the cam portions **61**, in cam portion peripheral areas E**11** and E**12**. Moreover, when the lever **6** is brought into the locked position, the moving arms **52**A and **52**B are raised. Accordingly, the space S for the raised moving arms **52**A and **52**B is required.

FIGS. **8**A and **8**B are cross-sectional views schematically illustrating the connector **1** according to the embodiment of the present invention, FIG. **8**A illustrating an even contact, FIG. **8**B illustrating an odd contact. This embodiment employs the following configuration to reduce the height around the cam portions **61**.

As for the odd contacts, as illustrated in FIG. **8**A, each fixed arm **51**A has such a shape that a part thereof corresponding to the cam portion peripheral area E**21** is cut off. The cam portion **61** is placed in the cut-out portion (in the portion where the fixed arm **51**A is not provided). In other words, the fixed arm **51**A is eliminated from the constituent components around the cam portion **61**. In such a structure that each contact **5** (fixed arm **51**A) is not sandwiched between the lower wall **32** of the housing **3** and the lever **6**, the height of the connector **1** of the embodiment in the locked position can be made shorter than that of the connector **1** of the comparative example by the thickness of the fixed arm **51**A.

Herein, a description is given of the reduction in height of the connector **1** in the locked position in more detail. As previously described, FIG. **1** is a view for explaining the problem of a conventional connector, A illustrating the state of the conventional connector before the lever **6** is turned, B illustrating the state thereof when the lever **6** is being turned, and C illustrating the state thereof after the lever is turned. The connector **1** according to the embodiment is effective in the case where the portion indicated by reference numeral **52**C in C is the highest in the moving arm **52**. Specifically, the height of the connector **1** in the locked position can be reduced because the moving arm **52** is located at a lower position by the thickness of the fixed arm **51** even if the moving arm **52** is raised by the cam portion **61** in the locked position. Compared to the conventional one, the highest point of the moving arm **52** in the connector **1** of this embodiment can be lowered even if the moving arm **52** is raised by the same amount.

In this embodiment, as described above, the position of the moving arm **52** is lowered including the initial position (the position before the lever **6** is turned), and the position of the moving arm **52** in the locked position is thereby lowered. To be specific, as illustrated in FIG. **8**A, in the housing **3**, the height position of a placement surface S**1** of the fixed arm **51**A in the vertical direction is substantially the same as that of a contact surface S**2** of the cam portion **61**.

In this structure, an end surface **51***e* of the fixed arm **51**A in the horizontal direction faces the cam portion **61**. To be specific, the end surface in the horizontal direction is an end surface thereof in the direction that the flat cable **2** is inserted. In other words, the end surface **51***e* of the fixed arm **51**A in the horizontal direction faces the cam portion **61** in the direction of insertion of the flat cable **2**. The connector can be therefore miniaturized in the horizontal direction as well as the height thereof can be reduced in the vertical direction.

As for the even contacts, each cam portion **61** has a columnar shape instead of the key shape. To be specific, in the comparative example, as illustrated in FIG. **7**B, the cam portion **61** has a key shape and is required to have a certain height for the bent portion of the key shape. On the other hand, in this embodiment, the cam portion **61** has a columnar shape as illustrated in FIG. **8**B. The diameter of the columnar shape, which is not particularly limited, only should be a proper diameter so that the height of the odd contacts equals to that of the even contacts. When the cam portion **61** has a columnar shape as described above, the cam portion **61** does not need to have a portion bent in a key shape. Accordingly, the height of the connector **1** of the embodiment can be shorter than the comparative example by the height of the bent portion of the key shape.

The cam portions **61** corresponding to the even contacts are to prevent the lever **6** from falling off and do not apply pressure to the contacts **5**B. Specifically, when the lever **6** is turned, the key-shaped cam portions **61** corresponding to the odd contacts apply pressure to the contacts **5**A to push apart the back ends of the fixed arms **51**A and moving arms **52**A. In this process, the columnar cam portions **61** of the even contacts are kept fitting in recesses **61***a* of the respective moving arms **52**B and take a role of preventing the lever **6** from falling off.

As described above, in the connector **1** of the embodiment, the height position of the placement surface S**1** of each contact **5** in the vertical direction is equal to that of the contact surface S**2** of each cam portion **61**. Therefore, the position of each moving arm **52**, including the initial position, is lowered, and the position of the moving arm **52** is accordingly lowered in the locked position. The height of the connector **1** can be therefore reduced.

To be specific, each contact **5** includes the moving arm **52** driven by the cam portion **61** and the fixed arm **51** fixed to the housing **3**, which are joined to form a substantially H-shape. The fixed arm **51**A of each of the contacts **5**A having short effective fitting length is shorter than the moving arm **52**A and is provided so as to face the moving arm **52**A together with the cam portion **61**. This structure can lower the position of the moving arm **52** at the locked position as described above. The height of the connector **1** can be therefore reduced.

Moreover, the end surface **51***e*, which is at an end of the fixed arm **51**A of each contact **5**A having short effective fitting length in the horizontal direction, faces the cam portion **61**. The connector **1** can be therefore miniaturized in the horizontal direction as well as the height thereof can be reduced in the vertical direction.

Moreover, the cam portions **61** corresponding to the short effective fitting length contacts rotate on the lower wall **32** of the housing **3**. Accordingly, the height of the connector **1** can be reduced by the thickness of the fixed arm **51**A.

When the lever **6** is turned, the cam portions **61** corresponding to the short effective fitting length contacts apply pressure to the contacts **5** while the cam portions **61** corresponding to the long effective fitting length contacts prevent the lever **6** from falling off. The thus-configured structure is effective when the signal terminals **21** of the flat cable **2** are arranged in a zigzag manner.

The cam portions **61** corresponding to the long effective fitting length are columnar. When each cam portion **61** has a columnar shape, the cam portion **61** does not need to include a key-shaped bent portion, and the height of the connector **1** can be reduced by the height of the key-shaped bent portion.

The short effective fitting length contacts are the contacts at the odd-numbered positions from an end, and the long effective fitting length contacts are the contacts at the even-numbered positions from an end. The thus-configured structure is effective because, generally, the contacts at the odd-numbered positions have short effective fitting length while the contacts at the even-numbered positions have long effective fitting length.

The preferred embodiment of the present invention is described above, but the present invention is not limited to the embodiment and can be variously changed. For example, the

cam portions **61** in the even contacts are columnar in the embodiment but may have another shape as long as the cam portions **61** take a role of preventing the lever **6** from falling off.

Obviously, various changes can be made without departing from the scope of the present invention.

What is claimed is:

1. A connector, comprising:

at least one of a contact;

a housing accommodating the contact;

an insertion opening to which a flat cable can be inserted, the insertion opening being provided in front part of the housing and being defined by upper and lower walls of the housing at the top and bottom; and

a lever which is provided in back part of the housing and includes cam portions which bring the contact into pressure contact with the flat cable and establish electrical continuity therebetween when the lever is pivoted, wherein,

the contact includes a first contact, and

in a state where the first contact is accommodated in the housing and the lever is provided in the housing, a placement surface on which the first contact is placed is substantially same height position in the vertical direction as a contact surface of a corresponding one of the cam portions in the housing.

2. The connector according to claim **1**, including a plurality of contacts, and wherein the contacts include a second contact having a different effective fitting length from that of the first contact.

3. The connector according to claim **1**, wherein the contact includes a moving arm and a fixed arm which are joined to form a substantially H shape, the moving arm being driven by the corresponding cam portion, the fixed arm being fixed to the housing, and

the fixed arm of the first contact is shorter than the moving arm and the fixed arm faces the moving arm and the cam portion faces the moving arm.

4. The connector according to claim **3**, wherein an end face of the fixed arm of the first contact faces the corresponding cam portion, the end face being located at an end of the fixed arm in the horizontal direction.

5. The connector according to claim **1**, wherein one of the cam portions corresponding to the first contact rotates on the lower wall of the housing as a contact surface.

6. The connector according to claim **2**, wherein when the lever is pivoted, the cam portion corresponding to the first contact applies pressure to the first contact while the cam portion corresponding to the second contact prevents the lever from falling off.

7. The connector according to claim **2**, wherein the cam portion corresponding to the second contact is columnar.

8. The connector according to claim **2**, wherein the first contact has an effective fitting length shorter than that of the second contact,

the first contact is located at an odd-numbered position from an end, and

the second contact is located at an even-numbered position from the end.

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